DOCUMENT RESUME

ED 109 506 CE 004 368

AUTHOR	Clague, Ewan
TITLE	Coal Manpower Projections: 1980. Final Report.
INSTITUTION	Kramer Associates, Inc., Washington, D.C.
SPONS AGENCY	Manpower Administration (DOL), Washington, D.C. Office of Research and Development.
PUB DATE	27 Sep 74
NOTE	69p.
EDRS PRICE	MF-$0.76 HC-$3.32 PLUS POSTAGE
DESCRIPTORS	Educational Needs; *Employment Projections; *Employment Statistics; Employment Trends; Labor Supply; *Manpower Needs; Productivity; *Skilled Workers; Statistical Analysis; Tables (Data)
IDENTIFIERS	*Coal Mining

ABSTRACT

The National Petroleum Council has projected a 1980 bituminous coal production of 910 million tons. On that basis, the study estimates the manpower which will be required to produce that volume of coal. On the assumption of a productivity increase of two percent per year from 1974 onwards, the 1980 coal output will require a work force of approximately 200,000, or about 45,000 above the 1973 employment figure. Additional workers needed to replace those who die or retire raise new manpower requirements to about 15,000 per year for the remainder of the decade. Because of the increasing mechanization of coal production, the most critical requirement will be for highly skilled workers. There will also be an urgent need for training programs, both in work safety and in mining skills, for young miners. The study supports its conclusions with numerous statistical tables and interpretations of their data. (Author/PR)

COAL MANPOWER PROJECTIONS, 1980

Final Report

Submitted to

Manpower Administration
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. Department of Labor
Washington, D. C.

by

Ewan Clague, Project Director
KRAMER ASSOCIATES, INC.
1225 Connecticut Avenue, N.W.
Washington, D. C. 20006

This report was prepared for the Manpower Administration, U.S. Department of Labor, under research and development contract No. DL P.O. 20-11-74-17 Since contractors conducting research and development projects under Government sponsorship are encouraged to express their own judgment freely, this report does not necessarily represent the official opinion or policy of the Department of Labor. The contractor is solely responsible for the contents of this report.

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No.
4. Title and Subtitle COAL MANPOWER PROJECTIONS, 1980			5. Report Date September 27, 1974 6.
7. Author(s) Ewan Clague, Senior Associate			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Kramer Associates, Inc. 1225 Connecticut Ave., N.W. Washington, D.C. 20036			10. Project/Task/Work Unit No. 11. Contract/Grant No. DL P.Q. 20-11-74-17
12. Sponsoring Organization Name and Address U.S. Department of Labor Manpower Administration Office of Research and Development 601 D Street, N.W., Washington, D.C. 20213			13. Type of Report & Period Covered FINAL 14.
15. Supplementary Notes			

16. Abstracts

Bituminous coal production of 910 million tons in 1980 was projected by the National Petroleum Council in their report on U.S. Energy Outlook, 1971-85. On that foundation this manpower study estimates the manpower which would be required to produce that volume of coal output. Productivity of labor in coal mining declined about 30 percent during 1970-73 under the impact of higher safety and health standards established by congressional legislation. On the assumption of a productivity increase of 2 percent per year from 1974 onwards, the 1980 coal output would require a work force of about 200,000 workers, about 45,000 above 1973 employment. Additional workers needed to replace those who die or retire would raise new manpower requirements to about 15,000 men a year for the remainder of the decade. The most critical requirement will be for highly skilled workers, such as mining machine operators, roof bolters, and others, who will be needed to man the increasing mechanization of coal production. There will be urgent need of training programs for young miners, both in work safety and in mining skills.

17. Key Words and Document Analysis. 17a. Descriptors

Economic Forecasting	Productivity
Manpower Requirements	Retirement
Mathematical Models	Skilled Workers
Orientation (training)	Statistical Analysis

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 5c. Economics,

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Distribution is unlimited. Available from National Technical Information Service, Springfield, Va. 22151.	UNCLASSIFIED	60
	20. Security Class (This Page) UNCLASSIFIED	22. Price

FORM NTIS-35 (REV. 3-72) THIS FORM MAY BE REPRODUCED USCOMM-DC 14952-P72

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SUMMARY

For two decades (1948-68) the bituminous coal industry achieved gains in productivity (output per man-day) which had the effect of reducing average annual employment in the industry from 436,000 in 1948 to 126,000 in 1968. Two factors were chiefly responsible for the employment decline. One was increasing mechanization in practically all phases of coal production; the other was a growing shift from underground mines to surface mines, primarily strip. The output per man-day in surface mines was about 2 1/2 times (recently 3 times) the daily output per man in underground mines.

Therefore, in projecting future employment in the industry there are three basic factors to be taken into account: (1) the prospective annual output of coal; (2) the proportions of that output produced by underground and surface mines respectively; and (3) the rates of increase in productivity in underground and surface mines, taken separately.

The most comprehensive analysis of the future prospects of the bituminous coal industry was made by the National Petroleum Council in 1971-72 as one phase of their study of the nation's energy crisis (U.S. Energy Outlook: An Initial Appraisal, 1971-85). Every possible source of energy (oil, gas, coal, atomic, etc.) was analyzed by task forces of experts who conducted special studies in depth for each source. In the case of bituminous coal the Council's committee projected a 1980 output of 910 million tons, with 430 million from underground mines and 480 million from surface mines (strip and auger).

On the subject of productivity (output per man-day) the Council's coal task force took account of the loss in productivity in underground mines due to the high-

er standards of safety and health required under the Coal Mine Health and Safety Act of 1969. However, they assumed that the bottom had been reached in 1971 and that some productivity improvement would begin in 1972. But that did not occur; there were some further declines in output per man-day in both 1972 and 1973. So in this present study 1973 productivity has been taken as the base, with the NPC estimated rates of improvement projected from 1973 to 1980. The increases estimated by the Council experts were approximately 3 percent per year for underground and about 1.3 percent for surface mines.

On the basis of those productivity increases the over-all manpower requirements by years to 1980 were calculated. Those estimates produced an expansion of roughly 5,000 additional workers per year -- from employment of 157,800 in 1973 to 193,200 in 1980.

As an alternative, another manpower projection was made, based on estimated annual productivity increases of about 2 percent in both underground and surface mines. The underground rate was lowered on the theory that the higher standards for dust levels set in 1973 would raise manpower requirements to some extent in future years. On the other hand, the estimated surface productivity (especially in strip mines) was raised on the ground that some shifting of production to the Middle West and Rocky Mountain States would bring higher levels of man-day output.

On the basis of those productivity estimates the average annual expansion in manpower would be about 6,500 workers, and total employment would reach 202,100 in 1980.

An additional manpower allowance must be made for active miners who

die or retire. The records of the United Mine Workers Welfare and Retirement Fund show retirements of between 3,500 and 4,000 annually during recent years.

Additional allowances must be made for the 30 percent of mine workers who are not members of the UMWA; for a residue of black lung cases which will occur during the next years; and for turnover from other causes. The total replacements needed for attrition from all causes has been estimated at approximately 9,000 men per year.

An effort has been made to estimate the occupational requirements for the the highly skilled occupations, those in Grades 4, 5 and 6. On the basis of a study made by the West Virginia Bureau of Employment Security a net increase of about 11,000 such jobs in underground mines and about 17,000 in surface mines has been projected.

The impact of this study for national manpower policy is that there will be an influx of some 15,000 new young workers per year into an industry which has had high rates of industrial accidents combined with high incidence of occupational disease. There is an urgent need for training in mine safety for all new entrants coupled with skill training for those who will be required to operate and maintain the complex machinery necessary for modern mining methods.

Responsibility for safety training lies in the Mining Enforcement and Safety Administration (MESA),* but it is likely that state employment services will be called upon to assist in recruiting young workers for the mines, underground and surface,, and also to assist in finding jobs for those miners who may want to leave the industry for health or other reasons.

* Department of Interior

It is recommended that the Manpower Administration direct the attention of the state employment services in the 25 states with significant coal mining activity to the possibility for placement and training in the bituminous coal industry.

INTRODUCTION

During World War II coal was one of the most critical and the most important raw materials in the U. S. economy. At one point the Federal government took control of the mines in order to insure a steady supply of coal for the war industries. After the war the expansion continued for several years. In the year 1948 annual employment in bituminous and lignite mines averaged 436,000 employees, with a peak of 450,000 in some months. Then began the competition of oil and gas as energy sources, with the result that employment dropped to 126,000 in 1968 -- a net loss of 310,000 employees, or more than 15,000 men a year on the average. A major factor in that decline was an astonishing rate of increase in productivity (output per manhour or manday) of about 6 percent per year over the two decades.

Anthracite had a far worse experience. From a 1948 total of more than 100,000 workers the employment in hard coal shrank to about 6,000. Hard coal ceased to be a major factor in the nation's economy.

However, in the case of bituminous a turnabout in the trends began to appear in the middle 1960's. Annual output reached bottom at 403,000 short tons in 1961, followed by a rise to 512,000 tons in 1965, reaching a peak of 603,000 tons in 1970. The outbreak of the war in Vietnam accounted for some of that upturn in output after 1965. Another factor was the marked expansion of strip mining from an output of only half that in underground mines in 1965 to practical equality in 1971.

Another signal of a change in trend came from the productivity figures. Output per manhour in underground mines began to slow down. The rate of increase in 1966 was 4.6 percent over the previous year, but it went down to 3 percent in 1967, 2.2 percent in 1968 and only 1.4 percent in 1969. However, the productivity rate for the industry as a whole did better over those years because of the differential in strip mining. Output per manday in strip mining is about $2\frac{1}{2}$ times the rate in underground mines. Hence the expansion of strip mining boosted the productivity for the industry as a whole. So, even though coal output was expanding substantially, employment continued to decline until the bottom was reached in 1968, according to the Bureau of Labor Statistics figures, or in 1969 as reported for average daily employment by the Bureau of Mines.

Then came the passage of the Coal Mine Health and Safety Act in 1969. That act established new standards for safety as well as new requirements for levels of coal dust in the air. The impact of that legislation upon employment and productivity was felt immediately in 1970, and it has continued its influence up to 1974. It is the experience of those years which provides the factual basis for future projections of coal employment.

THE FIVE-YEAR PERIOD, 1969-73

Coal production rose to a peak of 603 million tons in 1970, up about 42 million tons from 1969. After that it fell back. The figures are shown in Table 1.

The setback in 1971 was partly the result of the 7-week coal strike in October - November of that year. There was some expansion in production in the spring and summer in anticipation of the strike, but the output loss during the strike was substantially greater. The entire loss occurred in underground mines (63 million tons) partially offset by an output increase in strip mines of 15 million tons, which did not feel the effects of the strike to any significant extent.

In 1972 there was partial recovery of output in underground mines and a new peak in strip, but the year as a whole fell short of 1970. Then in 1973 underground production receded again, partially offset by a slight gain in strip, with the year as a whole falling a little short of the 1972 output. Strip mining in 1972-73 was feeling the effects of proposed new legislation regulating stripping. That prospect still looms ahead for the industry as of this writing in the summer of 1974. The future of strip mining will depend to a very considerable extent upon the requirements of that legislation, assuming that it passes in some form.

The employment experience of the last five years is shown in Table 2. A 7.6 percent increase in production in 1970 produced a 12.5 percent increase in

TABLE 1

Production of Bituminous and Lignite Coal
by Type of Mine
(Thousand Short Tons)

Year	Underground Mining	Surface Mining			Total
		Strip	Auger	Total	
1969	347,132	197,023	16,350	213,373	560,505
1970	338,788	244,117	20,027	264,144	602,932
1971	275,888	258,972	17,332	276,304	552,192
1972	308,905	269,609	16,872	286,481	595,386
1973	301,500	275,300	14,200	289,500	591,000

Source: U. S. Bureau of Mines.

TABLE 2

Employment at Bituminous and Lignite Coal Mines
by Type of Mine
(Number of Men)

Year	Underground Mining	Surface Mining			Total
		Strip	Auger	Total	
1969	99,269	22,323	3,940	25,263	124,532
1970	107,808	28,395	3,937	32,332	140,140
1971	109,311	32,979	3,374	36,353	145,664
1972	112,252	34,027	2,986	37,013	149,265
1973	119,900	35,000	2,900	37,900	157,800

Source: U. S. Bureau of Mines.

employment (15,000 men). All three types of mining had substantial increases in employment. Despite the strike there was no decline in average employment in the industry in 1971. Auger mines, with a substantial decline in their small output, saved about 500 jobs, but strip increased about 4500, and even underground, which bore the brunt of the strike, picked up 1,500 men.

The rise in employment continued through 1973, with a new high for the period of 157,800, the highest level since 1960.

Table 3 shows why employment has increased so much in the last few years, namely, substantial declines in productivity in the industry. In underground the decline has been continuous -- sharply downward in 1970 and 1971, and then further shading in 1972-73. Strip mining has remained at about the same level, with 1973 showing the lowest rate in that period.

Auger mines showed very good productivity results in 1972-73, but taken in conjunction with the decline in output, the results point to the closing down of the less efficient mines due to the application of the 1969 Health and Safety standards.

TABLE 3

PRODUCTIVITY AT BITUMINOUS AND LIGNITE COAL MINES

by Type of Mine

(Output per Man Day in Tons)

Year	Underground mining	Surface mining			Total All types
		Strip	Auger	Total	
1969	15.61	35.71	39.88	36.03	19.90
1970	13.76	35.96	34.26	35.83	18.84
1971	12.03	37.60	36.72	37.54	18.02
1972	11.91	35.95	43.00	36.36	17.74
1973	11.20	34.60	41.10	34.90	16.76

Source: U. S. Bureau of Mines.

OUTPUT PROJECTION, 1980

The most comprehensive study of the future of the bituminous coal industry was that made by the National Petroleum Council in 1971-72. Their basic report was issued in two volumes -- U.S. Energy Outlook, An Initial Appraisal, 1971-85. Subsequently the Council issued the Task Force Reports of its subcommittees. For our analysis here, we have drawn upon the 1973 volume on Coal Availability, a report by the Coal Task Group of the Other Energy Resources Subcommittee of the Council.

The basic projection required for a manpower study in coal is production. The NPC, using 1970 as a base, made projections of coal production as follows.

1970	590 million tons
1975	724
1980	910
1985	1,071

The 590 million for 1970 turned out to be too low -- the final figure was 603 million. Furthermore, they estimated 360 million tons in underground production, which left only 230 for surface. The revised figures were 603 million total, 339 underground and 264 surface.

As of 1980 the NPC estimated that the 910 million tons would consist of 430 million underground and 480 surface.

Since the NPC made its study two major factors have intervened to change the picture. First, the impact of the 1969 Health and Safety Act has put additional burdens and costs on underground mines, with some secondary effects upon surface mining. The 1971-73 production data, both for underground

and for surface, fall far short of the trend lines needed to produce 724 million tons in 1975. No subsequent year has yet reached the 1970 output.

The second event is the Mid-East War, which furnished stimulation for the achievement of the original projection. In the energy crisis one of the essential short-run (10-year) domestic energy sources is coal. The catastrophic price rises in oil have opened up market possibilities for coal, entirely apart from any policy decisions which the U. S. may have to make in getting coal production under forced draft. In brief, the original NPC output projection may turn out to be a good one, despite the low state into which coal production has fallen in the last few years.

A second problem concerns the share of the output produced by underground versus surface mines. The latter had been taking over the growth, with underground barely holding its own. However, as noted previously, surface mining is now under the threat of Federal regulation, which could limit its profitability and its prospective output. Since this legislation is still in the works it is essential to suspend judgment until the dimensions because clear.

For the purpose of this study we shall assume that the production data forecast for 1980 still represent the most likely outcome of the conflicting forces. Until more evidence is in, we propose to anchor to the NPC 1980 coal production projections.

Our next problem concerns the construction of output data for the intermediate years to 1980. The estimates are shown in Table 4.

TABLE 4

FIRST PROJECTION MODEL

BITUMINOUS COAL PRODUCTION PROJECTIONS

1974-1980

Year	Annual Production		
	Underground (000,000 tons)	Surface (000,000)	Total (000,000)
1970	339	264	603
1971	276	276	552
1972	309	287	596
1973	301	290	591
1974	319 1/	321 1/	640 1/
1975	338 1/	342 1/	680 1/
1976	356 1/	364 1/	720 1/
1977	374 1/	391 1/	765 1/
1978	392 1/	418 1/	810 1/
1979	411 1/	449 1/	860 1/
1980	430 2/	480 2/	910 2/

Source: National Petrolcum Council Coal Report adjusted by KAI for 1972-74 developments.

1/ Estimated by KAI

2/ Estimated by NPC.

We begin by assuming that 1974 will be a good year. It is already running well ahead of 1970. Some of this may be due to better markets for coal in substitution for oil. But some may be stockpiling in anticipation of a mine workers' strike next November. We have assumed that there will be a strike, but that it will be a short one -- not enough to upset the upward trend of coal production into 1975.

For the remaining years of the decade we estimate a fairly smooth upward growth of underground and surface mining, with the latter finally pulling ahead, until by 1980 surface is 50 million tons ahead of underground.

PRODUCTIVITY

The translation of coal production into manpower requires a productivity projection, or in fact two projections, because the productivity differential between the two types of mining is so great.

We have begun by accepting the productivity assumptions made by the NPC Coal Task Group. These have been charted in the Report on Coal Availability (p. 36, 37), with more detailed data supplied by members of the group.

The problem for us here is that the Task Group underestimated the drop in productivity in underground mining in 1971-73 (their estimate for 1970 was about right). In surface mines they did not foresee the decline in output per manday which took place in 1972-73. The question is (a) should we assume that these losses will be made up by 1980, so that the productivity levels that they originally assumed for 1980 will be achieved (which is the assumption we made for their output projections), or (b) should we assume that the annual rates of productivity increase which they selected will be controlling over the remaining years of the decade.

In this dilemma we have chosen the second alternative, although a case could be made for the first. We have assumed a speed-up in output to reach the original 1980 projections. Higher output often generates better productivity. However, our judgment is that productivity increases will be harder to achieve as health and safety standards are enforced. So we decided to stay with the NPC rates of increase.

On this point we have been somewhat surprised at their choices. For underground they selected an annual rate of increase which, on their productivity projection for 1972, amounted to 3.2 percent for the following year and then declined to 2.6 percent in 1980, with an average over the whole period of a little under 3 percent per year. Our adoption of their annual rate of .40 tone per manday gives us a higher productivity rate for the period, since we must measure from the bottom of 11.20 tons in 1973. So the rate in our projection starts at 3.6 percent in 1974 and dips under 3 percent only in the last year, 1980 -- an average of about 3.3 percent.

Such a productivity gain would require a substantial snap-back from the losses in the last three years. In view of the wide differentials in efficiency among underground mines, this choice may imply a closing down of the small marginal mines with lower productivity. But that would further imply that the efficient plants have achieved the safety standards without too much additional manpower.

Table 5 shows the effect of the productivity rate increase of .40 ton per manday. The resulting manday outputs (for example, 12.00 tons in 1975) were converted into uniform manyear outputs on the assumption of 225 working days per year. In actual experience there is always some fluctuation over the years, but 225 days is a very central norm.

This projection results in an average accretion rate of about 2,300 men a year. The total increase, 1974-80, would amount to 16,600 men.

For surface mines (Table 6) the NPC selected an annual improvement of .50 tons per manday, which averages out (on their assumed base) of a little

TABLE 5
FIRST PROJECTION MODEL
EMPLOYMENT PROJECTIONS
Underground Mines
(Productivity, 1974-80, about 3 percent per year)

Year	Annual production (000,000 tons)	Productivity (tons per man-day)	Additional labor (men)	Annual average employment
1970	339	13.76	-	107,808
1971	276	12.03	1,503	109,311
1972	309	11.91	2,941	112,252
1973	301	11.20	7,648	119,900
1974	319[1/]	11.60[3/]	2,300	122,200[1/]
1975	338[1/]	12.00[3/]	3,000	125,200[1/]
1976	356[1/]	12.40[3/]	2,400	127,600[1/]
1977	374[1/]	12.80[3/]	2,300	129,900[1/]
1978	392[1/]	13.20[3/]	2,100	132,000[1/]
1979	411[1/]	13.60[3/]	2,300	134,300[1/]
1980	430[2/]	14.00[3/]	2,200	136,500[1/]

Source: Bureau of Mines.

1/ Estimated by KAI

2/ Estimated by NPC.

3/ NPC yearly estimates linked to actual in 1973.

TABLE 6
FIRST PROJECTION MODEL
EMPLOYMENT PROJECTION
Surface Mines
(Productivity, 1974-80, about 3 percent per year)

Year	Annual production (000,000 tons)	Productivity (tons per man-day)	Additional labor (men)	Annual average employment
1970	264	35.83	-	32,332
1971	276	37.54	2,021	36,353
1972	287	36.36	660	37,013
1973	290	34.90	887	37,900
1974	321 1/	35.50 3/	3,200	41,100 1/
1975	342 1/	36.00 3/	2,100	43,200 1/
1976	364 1/	36.50 3/	2,100	45,300 1/
1977	391 1/	37.00 3/	2,700	48,000 1/
1978	418 1/	37.50 3/	2,700	50,700 1/
1979	449 1/	38.00 3/	3,000	53,700 1/
1980	480 2/	38.50 3/	3,000	56,700 1/

Source: Bureau of Mines

1/ Estimated by KAI

2/ Estimated by NPC

3/ NPC yearly estimate linked to actual in 1973

under 1.3 percent per year, and a little over 1.3 for our lower actual manday tonnage of 34.90 in 1973. In converting the manday output into the manyear, we have used 220 days as the standard for surface mines. The past record in the case of strip often shows 230-240 days of work, but the auger mines (which are included in the surface total) general operate only about 140-160 days a year.

On that basis employment would increase by 3,200 men in 1974 and create a total of 18,800 additional jobs over the period, an annual average of about 2,700.

The final step in the projection is the combination of the two types of mining into a total for the industry as a whole (Table 7). The result is an average annual expansion of employment of 5,000 men a year, and a total of 35,400 over the period.

It just happens that the average employment in the first 4 months of 1974 was 163,900 according to the monthly reports of the Bureau of Labor Statistics. This closely approximates the 163,300 in Table 7. However, it is still too early to tell whether this is a validation or a coincidence. The Bureau of Mines employment data, which we are using, sometimes differ from those of the Bureau of Labor Statistics. Furthermore, it will be a year before we can know how the total employment is divided between surface and underground.

On this projection the employment in bituminous mines in 1980 would be 193,200 men producing a total of 910 million tons of coal.

TABLE 7

FIRST PROJECTION MODEL

EMPLOYMENT IN BITUMINOUS COAL MINES

1974-80

Year	Annual production (000,000 tons)	Annual average employment	Additional labor (men)
1970	603	140,140	-
1971	552	145,664	5,524
1972	596	149,265	3,601
1973	591	157,800	8,535
1974	640 1/	163,300 1/	5,500
1975	680 1/	168,400 1/	5,100
1976	720 1/	172,900 1/	4,500
1977	765 1/	179,900 1/	5,000
1978	810 1/	182,700 1/	4,800
1979	860 1/	188,000 1/	5,300
1980	910 2/	193,200 1/	5,200

Source: Bureau of Mines

1/ Estimated by KAI

2/ Estimated by NPC

IV. PRODUCTIVITY AND MANPOWER PROJECTION, SECOND MODEL

The productivity estimates of the National Petroleum Council point in two directions: first, underground mines achieving a marked revival of productivity increases after five years of slowdown and decline, and second, strip mines encountering adverse conditions (through legislation) which would restrict their productivity increases to a fraction of their former gains.

Recent developments have altered the underground outlook. The full impact of the Health and Safety Act on employment and productivity in underground mines has turned out to be substantially greater than expected. The NPC Subcommittee could not have anticipated a loss of nearly 30 percent in output per manday in four years. Furthermore, there are indications of continued problems as the new higher standards of health and safety are applied by the Bureau of Mines. The legislation is still having a restraining effect on productivity, since more labor is required to establish and maintain the higher standards prescribed in the law. There is the further problem that the longwall method is not growing very fast, while the transportation problem of getting the coal out of the mine is not being solved quickly. Our estimate is a productivity increase of .25 ton per manday, or about 2 percent a year.

For this projection (Table 8) the annual manpower requirements in underground mines would amount to about 4,000 men. The total for the 7 years comes to 27,700. Employment in 1980 would reach 147,600 men.

With reference to surface mines, it seems unlikely that productivity increases will be restricted as much as the NPC assumed. The legislation

TABLE 8

SECOND PROJECTION MODEL
EMPLOYMENT PROJECTIONS
Underground Mines
(Productivity, 1974-80, about 2 percent per year)

Year	Annual Production (000,000 tons)	Productivity (tons per man-day)	Additional labor (men)	Annual average employment
1970	339	13.76	-	107,808
1971	276	12.03	1,503	109,311
1972	309	11.91	2,941	112,252
1973	301	11.20	7,648	119,900
1974	319[1]	11.45[1]	3,900	123,800[1]
1975	338[1]	11.70[1]	4,600	128,400[1]
1976	356[1]	11.95[1]	4,000	132,400[1]
1977	374[1]	12.20[1]	3,800	136,200[1]
1978	392[1]	12.45[1]	3,700	139,900[1]
1979	411[1]	12.70[1]	3,900	143,800[1]
1980	430[2]	12.95[1]	3,800	147,600[1]

Source: Bureau of Mines

[1] Estimated by KAI - NPC yearly estimates linked to actual in 1973

[2] Estimated by NPC

has not yet been adopted, and it might turn out to be more restrictive than anticipated. However, strip mining has such a differential advantage in labor costs over underground (now 3 to 1 in output per manday) that it has a good prospect of overcoming any cost handicaps imposed by the legislation. Therefore, we have estimated a productivity gain of about 2 percent per year, the same as underground. Table 9 shows the results.

For 1974 we have assumed the same .60 ton annual increase that was used in the First Projection. The current legislative battle in Congress is probably still operating to restrain strip mine expansion. However, assuming that this issue is resolved on a compromise level, we have increased surface productivity (including auger) to .75 tons per man per day. This estimate results in an expansion of employment amounting to 3,200 men in 1974.*

From 1975 on to 1980 the rise in employment ranges from 1,800 men in 1975 to 2,600 in 1979. The expansion of production from year to year has been assumed to increase gradually, while the output per manday is assumed to increase at a flat rate. This last assumption is based on the idea that public pressure for higher standards will continue to be exerted on the strip mine operators.

The two independent projections are brought together in Table 10, which shows that a total of 202,000 men would be required in 1980 to produce 910 million tons of coal. The average annual increase in projected employment is approximately 6,300, with a total increase over 1973 of 44,300.

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*In neither underground nor surface mines has any allowance been made for loss of employment due to a strike in November-December 1974.

TABLE 9

SECOND PROJECTION MODEL
EMPLOYMENT PROJECTION
Surface Mines
(Productivity, 1974-80, about 2 percent per year)

Year	Annual production (000,000 tons)	Productivity (tons per man-day)	Additional labor (men)	Annual average employment
1970	264	35.83	-	32,332
1971	276	37.54	2,021	36,353
1972	287	36.36	660	37,013
1973	290	34.90	887	37,900
1974	321[1/]	35.50[1/]	3,200	41,000[1/]
1975	342[1/]	36.25[1/]	1,800	42,900[1/]
1976	364[1/]	37.00[1/]	1,800	44,700[1/]
1977	391[1/]	37.75[1/]	2,400	47,100[1/]
1978	418[1/]	38.50[1/]	2,300	49,400[1/]
1979	449[1/]	39.25[1/]	2,600	52,000[1/]
1980	480[2/]	40.00[1/]	2,500	54,500[1/]

Source: Bureau of Mines

[1/] Estimated by KAI - NPC yearly estimates linked to actual in 1973

[2/] Estimated by NPC

TABLE 10

SECOND PROJECTION MODEL

EMPLOYMENT IN BITUMINOUS COAL MINES

Year	Annual production (000,000 tons)	Annual average employment	Additional labor (men)
1970	603	140,140	-
1971	552	145,664	5,524
1972	596	149,265	3,601
1973	591	157,800	8,535
1974	640[1]	164,900[1]	7,100
1975	680[1]	171,300[1]	6,400
1976	720[1]	177,100[1]	5,800
1977	765[1]	183,300[1]	6,200
1978	810[1]	189,300[1]	6,000
1979	860[1]	195,800[1]	6,500
1980	910[2]	202,100[1]	6,300

Source: Bureau of Mines

[1] Estimated by KAI - NPC yearly estimates linked to actual in 1973

[2] Estimated by NPC

In terms of productivity the increase in output per man per year is substantial, rising from under 3750 tons in 1974 to 4500 tons in 1980, a gain of 20 percent in 7 years. That is an average cumulative rate of 2.65 percent, which substantially exceeds the 2 percent rate for each type of mine. The higher combined rate is due to the shift in production toward surface mines, with their higher productivity levels.

V. PREFERENCE AMONG MODELS

Both the above models are based on a single total production projection, with the differences in manpower based solely on variations in productivity trends. However, it would be possible (a) to vary the total output projections up or down for the next 7 years, or (b) to vary the proportionate shares of underground and surface in the total.

Perhaps the greatest uncertainty at this moment in time is the future of strip mining. What Congress does this summer of 1974 (if they do anything at all) may govern the future of strip mining for the rest of the decade or longer. Rather than try to guess the character and scope of congressional legislation we prefer to stick with the original NPC projections.

There are two solid reasons for such a choice. First, the need to mine more coal as a growing source of U.S. energy needs will become more urgent with each succeeding year, thus insuring an expansion matching the NPC magnitude. Second, the tremendous productivity differential in favor of strip mining (3 to 1) should make it possible for strip mining to absorb substantial costs for land reconstruction without undercutting its competitive position vis-a-vis deep mining. It seems reasonable to assume that strip production will forge ahead of underground in the next few years, provided that the new requirements are not too onerous for strip survival.

This brings us back to the two models. Our preference is for the second. The standards established by law for health and safety in underground have cut productivity (output per manday) nearly 30 percent from the

1969 level. Furthermore, the pressure from the mine inspectors and from the union is sure to require more complete conformity to prescribed standards. In the light of present conditions in underground mines it seems safer to project a 2 percent productivity improvement for the rest of the decade than to count on 3 percent.

For strip mining a one percent productivity improvement over the next 7 years seems too low. We think that the surface mines (including auger) should be able to make 2 percent despite any likely legislative requirements.

VI. RETIREMENTS FROM THE MINE WORK FORCE

Over and beyond the new entries who will be required to meet the employment needs of the industry for the rest of the decade, there are two other sources of manpower requirements: (a) retirements because of age or disability, and (b) labor turnover arising from workers who have been separated by quits, layoffs or discharges, and who will need to be replaced.

The labor turnover item (b) is not significant for this survey, since it consists mostly of young workers who go into the industry and then go out again without trying to make coal mining a career. The records show that workers who plan to stay with the industry will seek jobs in other mines and will refuse referrals by the Employment Service to jobs in other industries. But the short-term young workers who enter and leave within a year or two constitute a manpower problem of a different kind. Such turnover has very little relationship to this longer range study of coal manpower.

However, the permanent retirement of older workers does constitute a replacement demand under present employment conditions in the mines. This was not always true. In the 20 years when employment in bituminous mining was shrinking every year (1948-68), retirements were generally not replaced. But since 1968 employment has surged upward, so that every separation leads to a new hiring.

During that long period of employment downturn the mine workers became about the oldest work force in any major industry in the U. S. Only the railroad workers exceeded them in the proportion of older workers. The following table shows the age distribution of miners over the decade of the 1960's.

TABLE 11

AGE DISTRIBUTION OF BITUMINOUS COAL MINERS
1961 - 70

Year Ending Dec. 31	Percent of Total in Age Group				Weighted Average Age
	Under 30	30 - 44	45 - 59	60 and over	
1961	2.9	40.8	49.5	6.8	46.0
1962	2.8	39.1	52.0	6.1	46.2
1963	3.8	36.7	53.1	6.4	45.1
1964	5.5	35.2	52.7	6.6	46.2
1965	6.6	33.8	52.9	6.7	46.1
1966	9.0	31.0	53.1	6.9	45.9
1967	11.4	32.5	49.6	6.5	44.9
1970[1/]	20.0	31.4	42.1	6.5	43.0

Source: Bituminous Coal Operators Association
Data derived from the UMWA Welfare and Retirement Fund.

1/ The December 31, 1970 data are the same as those presented by the UMWA Fund for January 1, 1971.

Note that the weighted average age remained practically stable at 46 years from 1961 thru 1966. Then came a marked drop to 43 years in 1970. In the older groups (60 and over, 45-59) the pattern is identical. Those miners passed through into retirement at a steady rate. Thus in 1966 exactly 60 percent of the work force was 45 years and over.

The point of interest here is the trends in the two younger groups. When combined they represented a steady proportion of 40 percent of the total.

But the numbers of men in the prime of working life (30-44) shrank steadily, year by year, as those men shifted into the 45-59 class and were not fully replaced by new entries in their 20's. The latter group expanded from 2.8 percent of the work force in 1962 to 20.0 percent in 1970.

These shifts have created a certain imbalance in the work force -- a shortage of miners in the middle years. The weight comes at the upper and lower ends of the age scale.

It is these older miners who will be retiring in the remaining years of the decade. The more precise pattern of the age distribution is shown in Table 12 for January 1971 and May 31, 1972. In this table the numbers are shown in five-year groups.

The percentages in this table are less significant than the numbers. From age 40 up through 60 and over the numbers are almost identical, showing that the aging of each group in the $1\frac{1}{2}$ years was offset by approximately equal replacements for the age group below. The total decrease in employment for the five groups combined was only 1,670.

However, below age 40 the new entries came in -- nearly 5,000 under age 25 and more than 5,000 between 25 and 35 years. Some of these represent short-term turnover, as noted above, but most of them constitute the new permanent work force in coal.

The significant point for the discussion here is the shrinkage at age 60. About 6,000 workers drop out at that age by death, disability or retirement. It must be emphasized that during the period January 1, 1971 to May 22, 1972 the Black Lung program was going ahead full speed, so some of those losses

TABLE 12

AGE DISTRIBUTION OF ACTIVE MINERS
MEMBERS OF UMWA WELFARE AND RETIREMENT FUND

Age Group	January 1, 1971 Number of Miners	January 1, 1971 Percent	May 31, 1972 Number of Miners	May 31, 1972 Percent
Under 20	1,151	1.10	1,679	1.47
20-24	8,713	8.32	13,115	11.48
25-29	11,035	10.55	14,292	12.51
30-34	10,261	9.81	12,304	10.77
35-39	9,644	9.22	10,727	9.39
40-44	12,887	12.32	12,361	10.82
45-49	15,429	14.76	15,069	13.19
50-54	15,847	15.15	15,571	13.63
55-59	12,813	12.25	12,590	11.02
60 & over	6,820	6.52	6,535	5.72
Total	104,600	100.00	114,243	100.00

Source: UMWA Welfare and Retirement Fund Surveys

could be reflecting the exodus of miners to the Black Lung benefits program administered by Social Security. But until the Social Security records have been analyzed fully there is no way of estimating how many previously active miners went out through that route.

The major source of employment decline in the older age groups is retirement on the Welfare and Pension Fund. On May 31, 1972, when there were 114,243 active miners recorded in the Fund, there were 65,776 miner-pensioners. Nearly 70 percent of those were 65 years or over, with the remaining 30 percent (nearly 20,000) being 55-64.

The experience of the Fund with respect to retirements since 1965 is shown in the following table.

TABLE 13

PENSIONS AUTHORIZED BY
MINE WORKERS WELFARE AND PENSION FUND

Fiscal Year (June 30)	Number	Fiscal Year (June 30)	Number
1965	6,494	1970	3,866
1966	8,317	1971	4,040
1967	4,404	Calendar Year	
1968	4,347	1972	3,671
1969	3,510	1973	3,622*

The retirements in 1973 do not include the 8,599 cases put on the pension rolls as a result of a court decision.

*Regular, not including Blankenship decision cases.

The Blankenship case was a class action lawsuit brought against the Trustees of the United Mine Workers of America Welfare and Retirement Fund of 1950 by more than 70 retired miners and widows in 1969. The suit was filed to challenge various regulations of the Fund concerning eligibility for pension, health, and survivor benefits.

The final settlement of the case came on February 22, 1973. Many previously ineligible retired miners became eligible for pension and hospital benefits and some widows became eligible for one-time survivor benefits.

The settlement does not affect any retired or working miners currently receiving pension and/or health benefits from the Fund. An early projection (UMW Journal - January 1, 1973) assumed that 17,000 retirees could become eligible for the pension and hospital benefits and 3,000 widows would qualify for its survivor benefits.

That decision applied to old cases who had been denied pension benefits by the management of the Fund. It has been estimated by officials of the Fund that only a tiny fraction of those cases could possibly have been active miners in recent years.

In Table 12 it was noted that slightly over 19,000 miners were in age groups 55-59 and 60 and over. All of those are already eligible by age (55) for retirement on the Fund. Another 15,571 will also be eligible by 1980. In fact, a fraction of the 45-49 group will also reach that retirement age by 1980 -- a reasonable estimate would be 4,500. That makes a total of over 39,000. Some of those have already retired in the last $1\frac{1}{2}$ years; on a strictly proportionate basis that would be about 6,000 men. That leaves 33,000 men reaching retirement age in six years, or 5,500 a year.

Of course, not all those men will retire as soon as they are eligible. The sharp drop in employment after age 60 has already been noted. It can safely be assumed that those men now in the early 50's or late 40's will not all retire promptly in 1979-80, when they will be in the late 50's and early 60's. On balance, we would estimate that the actual retirement rate will be nearer 4,500 a year.

Next, some allowance must be made for the retirement of miners not in the UMWA Fund. These are estimated at about 30 percent of the total mine labor force. Many of them are non-union workers with much smaller retirement benefits. Others are strip miners who are younger (recent expansion of strip) and administrative/clerical workers. As a group they will have fewer retirees. Our estimate is 1,000 retirees a year.

Some allowance must also be made for Black Lung benefits in the future, that is, for miners not eligible by length of service (20 years) for UMWA pension benefits. (If the Black Lung miner is eligible to retirement benefits he can get both, and therefore is already counted among the Fund pensioners). Furthermore, large numbers of miners failed to take X-rays in the first program. It is thought that some of these were miners in their early 50's, fairly close to qualifying for a pension by age and/or service, but not wanting to be retired on Black Lung benefits only. Those men may already have Black Lung, or they may get it by their further work in the mines. For these and for other accident and disability cases we have made an estimate of 2,000 men a year for the first two years and 1,500 for the next five.

Short-term turnover has been excluded from these estimates, but there is a longer-term for which such an allowance must be made. Those are career men of one year's experience or more who decide to leave the industry for some reason or another -- death, moving to another state, taking a job in another industry, having been discharged, etc. From such meager data as are available we have estimated a rate of about one percent a year.

In summary, we estimate that the attrition of coal manpower from these various sources would be as follows:

Regular retirement	4500 workers a year
Outside United Mine Workers	1000 workers a year
Black Lung in the future	2000 for two years, then 1500 a year
Turnover from other causes	1 percent a year

VII. MANPOWER REQUIREMENTS

In estimating future manpower requirements it is necessary to add the replacements for attrition to the new entrants for additional labor. Using the second projection model we arrive at the following estimates.

TABLE 14

MANPOWER REQUIREMENTS
ATTRITION REPLACEMENTS AND NEW ENTRANTS
1974-80

Year	Employment	Attrition Replacements	Additional Labor	Total New Requirements
1970	140,140			
1971	145,644		5,524	
1972	149,265		3,601	
1973	157,800		8,535	
1974	164,900	9,150	7,100	16,250
1975	171,300	9,200	6,400	15,600
1976	177,100	8,770	5,800	14,570
1977	183,300	8,830	6,200	15,030
1978	189,300	8,900	6,000	14,900
1979	195,800	8,950	6,500	15,450
1980	202,100	9,000	6,300	15,300

The additional labor required averages somewhat more than 6,000 men a year, and the attrition a little less than 9,000 on the average. The total requirements amount to more than 15,000 men a year, or a total of about 107,000 through 1980.

It is necessary to reiterate at this point that the above tabulations do not take into account a substantial volume of short-term turnover of new workers who enter the industry and then leave it without making a career. Nor does it include the large-scale voluntary quits of workers who leave one employer and go to another within the industry. In other words, these figures must not be confused with regular labor turnover statistics compiled from the records of individual companies.

VIII. OCCUPATIONAL PROJECTIONS

The objective on this point is to analyze the manpower requirements of the bituminous coal industry for the purpose of estimating the numbers of skilled workers who would be needed in order to produce the output of coal projected in the model.

Occasional wage surveys made by government agencies, such as the Bureau of Labor Statistics, provide some scattered information on the occupational pattern of coal mine operations. However, none of these have been conducted recently.

Manufacturers of mining equipment usually have patterns of manpower requirements for their various machines. But these are not representative of the industry as a whole. Nor is there any way to translate those requirements into an industry-wide pattern.

About the only information available which contains detailed classifications of coal mining jobs in underground and surface mines comes from two state-wide surveys by the state of West Virginia Bureau of Employment Security -- one in 1960 and the other in 1970.*

This was a project conducted in cooperation with the Manpower Administration of the U. S. Department of Labor in order to provide "a complete occupational-industrial matrix and to make manpower projections based on this matrix."

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*A Study of Optimum Sample Selection and Occupational Patterns in the Bituminous Coal Mine Industry of West Virginia. 1971

In the bituminous coal industry an "attempt was made to collect occupational information from the universe of establishments." This was done by sending questionnaires to a stratified sample of coal mining establishments. The sample response contained 78.24 percent of total employment in the bituminous coal industry in West Virginia in December 1970. A total of 297 occupations were represented in either or both the 1960 and 1970 tabulations.

The next step was to classify those occupations into the pay scales set forth in the 1971 collective agreement between the Bituminous Coal Operators Association and the United Mine Workers. The agreement has six grades of wage scales into which are classified all the job titles that are found in the bituminous coal industry.

The distinguishing feature of these six classifications is the daily wage rate which is designed to reflect the differential skill levels of the work force, at least to the extent that these can be fitted into six grades of skill. As an example, in November, 1973, the daily pay scale in underground mines ranged from $42.25 in Grade 1 to $50.00 in Grade 6. A similar set of six grades has been established for strip and auger mines, with approximately the same scales of pay, except that there is a small difference in favor of underground workers in all grades below Grade 6. Thus, Grade 5 underground is set at $47.25 per day, but in strip and auger it is $46.00. Similar differentials exist in the other lower grades. In preparation plants and other surface facilities, there are no Grade 6 workers and all the other five grades are paid a shade lower than strip and auger. For example, a mechanic helper in surface facilities has the status of Grade 3 at $41.75 a day. But a mechanic helper in strip and auger is paid $42.00 and another one in underground receives $42.75.

For the purpose of developing a projection of occupations in the bituminous industry, it was necessary to determine the distribution of the West Virginia work force in the various pay grades, particularly Grades 4-6, which consist of the three highest levels of skilled miners. With this objective in mind, absolute figures of employment within various mine occupations were obtained from the West Virginia survey. As many as possible of the occupation were assigned to one of the six pay grades. A totaling of these numbers produces a base figure for each level of skill from which 1970 and 1980 national levels can be calculated.

While the West Virginia survey reported 297 occupations in the entire industry, the number of job titles listed in the 1971 agreement approaches 400 in underground mines alone. This significant disparity is due to the method of job classification. The mine workers' agreement is designed to include every job title which is in current use in the industry anywhere in the country. The Department of Employment Security, on the other hand, coded all occupations to the more inclusive 9-digit DOT (Dictionary of Occupational Titles) detail. Consequently, while some job titles appearing in the agreement are universal throughout the industry and correspond to DOT occupational coding, others may be limited in usage to a particular region, state, or locality and would not appear in the DOT list.

This difference in method of classification frequently created difficulties. For example, the DOT occupational code Electrician was not sufficiently detailed to permit positive distinction between Grade 6 Electrician, experienced and Grade 5 Electrician, Second Class.

As can readily be seen, the classification of the West Virginia survey occupational data into pay grades was based on judgment. Was the person skilled or unskilled, and if skilled, just how skilled? In the instances of those occupations that were solely indigenous to one type of mining the problem was minimal, but those occupations that appeared in both surface and underground operations required additional information. Several cases exist wherein the same occupational title is assigned to varying pay grades dependent upon which variety of mine is involved. Examples of these include: Welder, First Class, a Grade 6 in underground but a Grade 5 in surface; Crusher Operator, a Grade 2 in underground but a Grade 4 in surface; and Dumper, a Grade 2 in surface but a Grade 4 in underground.

Problems such as these were resolved by distributing the number of workers in each occupation concerned to the underground or surface work force in the same proportion as the total employment in the type of mining to the total mine employment in West Virginia.

Upon identifying the difficulties or incorporating the two sources of information and establishing a system of adjustment for them, the task of measuring the size of each pay grade in West Virginia was undertaken. Although the responses to the West Virginia survey had provided only 78 percent of the state's mine employment, the figures in the tables had been expanded to show the occupational breakdown of 100 percent of the work force. After assigning each job title to its proper pay grade, it was these already inflated figures that were used to arrive at a total employment size for each level of skill. Table 15 is the result. The classification "all others" includes foreman, the three lowest pay grades, clerical staff, and other miscellaneous employees.

TABLE 15

PAY GRADE DISTRIBUTION OF WEST VIRGINIA MINE EMPLOYMENT
1970

Underground Mines			
Grade 6	6,300		
Grade 5	5,400		
Grade 4	2,200		
Total Grades 4, 5, and 6		13,900	
All Others		27,400	
Total Underground Mine Employment			41,300
Surface Mines			
Grade 6	900		
Grade 5	2,250		
Grade 4	1,800		
Total Grades 4, 5, and 6		4,950	
All Others		850	
Total Surface Mine Employment			5,800
Total Mine Employment in Grades 4, 5, and 6		18,850	
Total West Virginia Mine Employment			47,100

Note: While figures shown on tables have been rounded to nearest units of fifty, exact figures were used in tabulations.

(It should be noted that the six classifications listed in the mine workers' agreement are not precise determinants of levels of skill. They are only general guidelines. Even within each pay grade a wide range of skills may be prevalent. Grade 5-A, Cutting Machine Operator, for example, includes both operator and helper).

The 1970 underground mine employment in the state of West Virginia represents 39 percent of the underground mine employment in the nation and produces 34 percent of the total tonnage of bituminous coal mined in the U. S. for that year. As such, it can be considered a reasonably representative sample of the national underground mine community.

By increasing each pay grade 2.6 times, the size of each pay grade nationwide in 1970 is obtained. However, before these new base figures can be projected to 1980 levels, two vital factors must be taken into consideration. The first of these is the projected increase in total coal production in underground mines. Annual production of 340 million tons in 1970 is estimated to increase by 1980 to 430 million tons or for our purposes, in an amount of 1.3 times.

The 1.3 production growth can not be applied to our pay grade populations, however, until allowance is made for any change in productivity, the second factor. An increase in productivity, if large enough, would have the effect of requiring fewer miners in 1980 to produce larger amounts of coal.

In the case of the underground mines, productivity experienced a dip in the period 1970-73, but is expected to recover by increasing at an annual rate of 2 percent. Despite this prospective increase in productivity, there

will be no net gain in 1980 over 1970. In other words, productivity in 1980 is estimated to be restored to the level of 1970.

In this age of technological development and increasing reliance upon coal as a source of energy, a 2 percent growth rate in productivity might seem small. However, it must be kept in mind that technical advancement is not the only force influencing mine productivity. Increased application of health and safety standards will be augmenting the labor force as new techniques and equipment tend to reduce it.

This influx of new employees with functions oriented to maintaining or increasing safety, as opposed to directly mining coal, will be felt in all categories of skill. For example, Grade 6-D is likely to see increased numbers and varieties of fire bosses and Gas Watchmen and Grade 5 should experience a growth in the number of Roof Bolters and other occupations designed to prevent cave-in disasters. In making the 1980 projection we have assumed a broad-gauge increase across all levels of skill.

By applying the ratio of 1.3:1 to the 1970 base employment figures in grades 4; 5, and 6, we obtained the projected levels of employment in each of the three highest skilled pay grades of underground mines for 1980. Table 16 illustrates the results.

TABLE 16

PROJECTED EMPLOYMENT IN UNDERGROUND MINES
1980

	1970	1980
Grade 6	16,300	21,200
Grade 5	14,100	18,300
Grade 4	5,750	7,500
Total	36,150	47,000
All Others	71,650	100,600
Total Underground Mine Employment	107,800	147,600

The 1980 employment levels exhibit an estimated growth in each pay grade of approximately 30 percent. However, it should not be assumed that the new members within each pay grade will be new entrants to the overall mine work force. Due to the extensive stratification of occupations in underground mining, the source of the vast majority of these higher skilled employees lies within the industry itself. Vertical mobility is prevalent in the underground mine industry, particularly in the unionized sector.

In dealing with projections for surface mine employment, additional adjustments and computations were required. The first distinction necessary was the relative size of the two types of surface mining, strip and auger mines. Nationwide employment in the strip mine industry constitutes 88 percent of the total employment in surface mining. Accordingly, our base figures for each pay grade in the surface mines were assumed to be distributed in strip and auger mines in like proportions and tabulations were performed to reflect this.

Before expanding these figures to national levels, an adjustment was necessary to content with the variance of productivity in surface mining that exists between West Virginia and the nation as a whole. West Virginia's productivity in both strip and auger mines is roughly 75 percent that of the national average. In a crude sense, this means that nationally three strip or auger miners are producing the equal amount of four of their counterparts in West Virginia. Consequently, for our sample to be truly reflective of the nation, it must be reduced by a corresponding amount.

After deflating the pay grade figures to obtain productivity-adjusted base figures, they were increased 7.4 times. Although West Virginia surface employment is actually 18 percent of the total surface employment, adjusting for productivity reduces our sample's size to 13.5 percent and thus the 7.4:1 ratio. The increased base figures became our 1970 national levels of employment in pay grades 4, 5, and 6 in auger and strip mines.

The predicted growth of production in the strip mining industry from 1970 to 1980 is 1.9 times. When coupled with an expected growth in productivity per man of approximately 10 percent, an adjusted growth of 1.7 times is predicted for the strip mines work force. Auger operations, on the other hand, are not expected to display any significant growth in production or employment and consequently employment levels are looked upon to hold constant during the ten year period. Table 17 displays the projected national employment levels and pay grade distribution in surface mines in 1970 and 1980.

TABLE 17

PROJECTION OF EMPLOYMENT IN SURFACE MINES
1980

	1970			1980		
	Strip	Auger	Total	Strip	Auger	Total
Grade 6	4,300	600	4,900	7,300	600	7,900
Grade 5	11,800	1,450	13,250	20,000	1,450	21,450
Grade 4	8,650	1,200	9,850	14,700	1,200	15,900
Total	24,750	3,250	28,000	42,000	3,250	45,250
All Others	3,750	650	4,400	8,600	650	9,250
Total Surface Mine Employment	28,500	3,900	32,400	50,600	3,900	54,500

The figures indicate a spectacular estimated growth in employment levels of strip mining approaching 70 percent. As can be seen, the majority of workers in this type of mine are in the highest skilled categories. This is largely due to the nature of the operation itself, highly mechanized and equipment oriented. Vertical mobility exists in surface mining, though to a lesser extent than in the underground branch of the industry. The largest influx of new workers can be expected to be felt in Grade 4 by employees new to the mine industry, perhaps, but already familiar with the operation and maintenance of mobile equipment. As they gain more experience and hone their skills with machinery characteristic of strip mining, the upward flow into higher pay grades will begin.

IX. SKILLED JOBS

In the selection of specific occupations for further study and analysis, three criteria were used: (a) the job should be so sharply defined that the statistics of employment in the job are comparable from year to year; (b) employment in the job should be large enough to make it a significant factor in coal manpower; and (c) sufficient skill must be required to warrant the establishment of training programs within the industry, or through the government.

The advantage of using these criteria is that they focus upon the larger highly skilled worker groups. The disadvantage is that they omit some highly skilled essential occupations which have very small numbers. For example, mining engineers constitute a small group of university trained professionals who are critically important. Then there are the foremen in various mine operations who constitute a large key group in achieving maximum production. However, their skills are specialized in their respective fields, although they have a common generalized skill as managers of the various mining operations.

The following table shows the 1980 projections for six occupations in underground mines.

TABLE 18

SKILLED OCCUPATIONS, UNDERGROUND MINES
1980 PROJECTIONS

Title	Grade	Number of Workers		
		West Va. 1970	Total U.S. 1970	Projection 1980
Continuous Mining Machine Operator	6	1,420	3,700	4,800
Fire Boss	6	230	400	500
Longwall Machine Operator	6	125	330	450
Roof Bolter	5	2,480	6,500	8,500
Universal Cutting Machine Operators Helper	5	790	2,000	2,700
Jackman	4	290	800	1,100
Mason	4	90	250	350

The continuous mining machine operators constitute one of the key occupations. There is almost certain to be a steady expansion of continuous mining as a result of the energy crisis. On the other hand, the superior productivity of continuous mining would operate to reduce the number of machines needed for a given volume of coal production. Similarly, the longwall method has a strong potential for the future and is being studied by the office of Research of the Bureau of Mines. The immediate problem may be a shortage of longwall machines, although that should be overcome in the longer run. Our judgment would be that longwall machine operators will be considerably more numerous than this estimate. At this writing it seems likely that longwall is the coming method in underground mining.

As the longwall method of mining proliferates it seems valid to assume that the method most frequently replaced will be the universal cutting method, thereby decreasing the demand for cutting machine operators and their helpers. Cutting machine operations require the most workers and processing at the present time. While this may be true in established mines, increased demand for coal will bring about new mines, many of which will not readily lend themselves to the longwall method of mining. The demand for skilled cutting machine operators for mines such as these is likely to increase. As helpers become fully qualified, an increased demand for assistants and trainees can also be expected.

The category of fire boss and its related occupations is certain to experience an increase in demand for its particular skill. The opening of new mines would be sufficient in itself to provide more positions. However, the larger factor in increasing demand will be the growing application of health and safety standards. As more miners go underground, a larger force of workers to combat the possibility of respiratory damage will be needed.

Increasing the safety of working conditions in underground mines will also call for more roof bolters and their related occupations. For such an extremely important occupation, it is essential that training in this skill must leave no uncertainty that those performing the task are fully qualified.

Grade 4 in underground mines is a level of skill that serves as a stepping stone to higher qualifications. Grade 4 consists of a heterogenous grouping of jobs with a myriad of occupations that certainly require training and ability, but in which the skills are not as fully developed as those positions in Grades 5 and 6. Jackman and Mason are examples of occupations that necessitate the

high level skill but once these skills are mastered the worker can advance to an even more skilled role in the mining process.

The future of growth of the strip mine industry hinges largely on the extent to which it is prohibited or regulated. The central issue is restoration of the land to its national contours once the available supply of coal has been exhausted. The decision by the mine operators as to which workers will be assigned to this restoration could greatly affect the growth of individual pay categories. Should it be considered logical that the initial process of removing the top layers of earth need just be reversed to restore the work site, a general increase in all occupations could be expected. However, it might not be profitable for the mine operators to pay the prevailing wage rates of the higher skilled levels to perform such work. The possibility would then exist for the strip mines to employ a substantial increase in the lower skill grades than is projected in our estimates.

There exist strip mine locations in terrain that is such as to preclude the possibility of restoration to original condition. In some forms of possible strip mine regulation these might be totally prohibited by the new legislation. Such a ban would undoubtedly decrease the required number of new equipment operators.

However it is yet too early to make any valid assessment of those possibilities. The occupations listed in the following table and discussed below are treated on the assumption that the future employment requirements of the strip mine industry by pay grade will continue in present proportions.

TABLE 19

SKILLED OCCUPATIONS, SURFACE MINES
1980 PROJECTIONS

Title	Grade	Number of Workers		
		West Va. 1970	Total U.S. 1970	Projection 1980
Power Shovel Operator	6	140	775	1,320
Stripping Shovel Operator	6	55	310	530
Stripping Shovel Oiler	5	40	220	375
Bulldozer Operator	4	800	4,500	7,600

Just as in underground, it is the machine operators who constitute the backbone of the strip mining operation. In strip mines it is the power shovel operators and stripping shovel operators who govern the output. Our projections indicate that there is likely to be a major increase in both classes of employees. Taken together they show an increase from 1,085 in 1970 to 1,850 in 1980, an increase of over 70 percent. That estimate is based on the assumption that the forthcoming strip mine legislation will not be so onerous as to put it out of competition with underground mines. With a productivity differential of 3 to 1 in output per manday, stripping could absorb some increased costs of land rehabilitation. On the other hand, we have not assumed a high rate of productivity increase in strip in the immediate future years.

Whatever happens in strip legislation it is likely that bulldozer operators will be in heavy demand. Not only do they constitute one of the largest occupations in stripping operations, but they are likely to have the assignment of putting the stripped land back in shape. There could be an expansion of considerably more than 3,000 in this job.

Furthermore, bulldozer operators move up the grade scale by becoming stripping shovel oilers at Grade 5. That in turn become an entry job to shovel operator. We have assumed that all these occupations will expand in rough proportions.

Another large occupational group in strip mining is the truck drivers. Unfortunately for our occupational analysis it has not been possible to distinguish precisely in the West Virginia agency classifications the two distinct categories of truck drivers. At the higher level (Grade 4) are the heavy truck drivers who transport the coal from the stripping operations, or refuse truck drivers who operate similar heavy trucks. At a substantially lower level (Grade 2) are the light truck drivers, such as utility and supply truck drivers, water haulers and others. As a result it has not been possible to project on any sound basis the future requirements of Grade 4 truck drivers, important as such an occupation is in the industry.

X. MANPOWER POLICY

If these manpower projections for the remainder of the decade are anywhere near the acutal result there will be a need for manpower policies designed to improve the safety record, the health record and the productivity performance of the bituminous coal industry.

The almost universal experience in American industry is that an influx of new young workers into an industry worsens the accident record. The best way of overcoming this is intensive training of entry workers in accident risks and safety practices. For the coal industry this is the responsibility of the Mining Enforcement and Safety Administration of the Department of the Interior.

Assistance in the recruitment of young workers for the coal industry is a function which the state employment services could perform. In past decades, with coal mine employment declining every year, and with very few new entries, there was very little that a public employment service could do, especially since many of the entrants were local inhabitants of the mining communities. But with the marked expansion of coal mine employment in the last five years there has been a change in the new recruits. The opening up of new coal fields in the newer coal states, coupled with the high wages of coal miners, has attracted young workers into the coal fields. The geographic shifts which are in prospect for expanded coal production offer additional opportunities for public employment service placement.

While the Black Lung Benefits program operated by the Social Security Administration has swept up the health-disabled miners from the coal fields,

there are still some long-service miners who have not participated in the X-ray program and who may be partially afflicted with black lung. It is likely that some of these will become black lung cases and will have to retire from mining during the next five years.

However, such retired miners would be ineligible for any work in the mines (except with loss of benefits); but they could work in other industries without loss of benefits. Here the public employment services could offer their services for such placement activity.

Furthermore, some of the higher-level occupations in the mines require high degrees of skill in operating and maintaining the complex and highly productive machinery used in modern mining methods. High skills are needed in these occupations (a) to avoid accidents and (b) to improve the productivity in coal production. This is another area in which the Manpower Administration could make an important contribution.

Finally, there is the possibility that the coal industry will be required to make a higher contribution to the solution of the energy crisis than the production projected by the National Safety Council prior to the MidEast War, and prior to the world-wide restriction of output by the oil-producing countries. Coal is a domestic U.S. resource, which could under a crash program become a substantially greater energy source than is now in prospect.

If such a program is adopted there will be additional manpower requirements, not only in coal mining itself, but in supplementary industries such as rail transportation and pipeline (coal) construction.

In the light of such real and potential possibilities it is recommended that the Manpower Administration direct the state employment services in the 25 coal states to analyze the developments in their respective states and gear themselves to participate in the placement and training activities which will be necessary for the achievement of the manpower objectives, whatever those turn out to be when the nation makes its decision.

APPENDIXES

A. Postcript on Occupational Projections

B. Bibliography

A. POSTSCRIPT ON OCCUPATIONAL PROJECTIONS

Limitations of available data have handicapped us in making estimates of both the future overall manpower requirements in the bituminous coal industry and the more precise requirements for specific highly skilled occupations. The Employment Security Agency of the state of West Virginia is to be congratulated on the efforts they have made to obtain state-wide occupational data by 9-digit job titles in 1970, and previously in 1960. The section of the report on occupational projections is based on West Virginia data converted to nation-wide totals in 1970 and then to projections in 1980, supplemented by the grade classifications of job titles listed in the labor-management contract of 1971.

One limitation is that the 297 occupational classifications in the West Virginia surveys are not sufficiently detailed to match the pay scale classifications in the 1971 contract, which mentions as many as 1,000 job titles classified into six precise daily pay scales, with minor modifications in the surface operations -- (a) strip and auger and (b) preparation plants and other surface operations. In the case of sharply defined occupations, such as continuous mining machine operator, longwall machine operator, welder first class, fire boss and roof bolter, it was possible to obtain reasonably complete and accurate figures from the West Virginia surveys on a definitive job or a closely related family of jobs.

However, in other cases the number and diversity of job titles in a single grade classification made it difficult to decide how the West Virginia titles fitted into the grades in the contract. The term electrician includes more than a score of job titles covering a wide range of jobs of varying content. The term "mechanic" is equally broad.

Another factor which further diffused the skill content of a job title is the established practice in mines covered by the UMWA contract of posting and bidding on job vacancies within the mine. When a vacancy occurs it must be posted for 5 days to permit employees an opportunity to bid for it. Seniority governs among those found to be qualified. One result of this practice is that many miners in the higher pay grades have had a variety of work experiences and can qualify for a variety of skilled jobs. Another result is that the entry jobs in the industry are in the lower pay grades, from which the miner expects to work his way up as opportunities arise.

Still another limitation in working with data from two different sources is the difficulty of matching titles and jobs. As mentioned above, truck drivers show wide divergence in degree of skill and pay. Car dumpers with various descriptive adjectives appear in underground mines at Grade 4, but at Grade 2 in strip and auger and also in surface facilities. Thus we were unable to classify by pay grade the various truck driver titles that appear in the West Virginia survey.

Finally, one point stands out in sharp relief in this whole study of occupational projections, namely, the lack of a productivity factor (output per manhour, or per manday). What we have had to work with in the occupational data from the West Virginia surveys is a mixture of good, medium and poor operations in bituminous mining. There is no way of discovering the patterns of related jobs which are growing as distinct from those which are being phased out.

The missing factor in this study is the impact of productivity and efficiency on future occupational patterns in an industry. What is needed here is a selection of the most advanced (efficient) mines in the industry, underground or surface,

coupled with the occupational patterns in those mines. It is a well known thesis in the field of occupational projections that the patterns which are found in the most advanced plants in an industry today will constitute the prevailing pattern in the industry at some time in the future. During that period the least efficient plants with their occupations will have dropped out of the industry. Those plants foreshadow the labor displacements which will take place in coming years. That is what occurred in bituminous coal in the 1950's and 1960's.

Advanced plants may be determined by types of production which are widely recognized in the industry as being the wave of the future -- the longwall method in mining, for example. However, to estimate the rate at which the most advanced plants will dominate the industry some productivity data are needed. The concept is that the wider the productivity differentials existing in the industry, the sooner the occupational transition will take place. Of course, diversional factors have to be taken into account. No projections in coal manpower can be made without evaluating the effect of the health and safety standards which may (and have already) offset the rise in productivity.

But the principle of occupational changes related to productivity is still sound. It is our judgment that projections based upon the present occupational patterns of the most efficient mines would produce better results than we have been able to obtain here in the absence of such information.

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